Polishing a Hidden Gem: A Novel Evaluation Method for Energy Codes & Standards Programs

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ABSTRACT

This paper offers a novel approach for estimating program attribution and related energy savings for code compliance programs. This approach was successfully incorporated into a 2017 study of National Grid's Rhode Island Code Compliance Enhancement Initiative (CCEI). The study estimated the 2018-2020 savings attributable to the CCEI due to increased code compliance in the residential and commercial new construction markets. The logic developed to support this approach provides a replicable model for other energy code support programs.

Background

The CCEI is designed to improve compliance with Rhode Island's residential and commercial building energy codes. In 2017, National Grid contracted with NMR to estimate the savings due to enhanced code compliance in the residential and commercial new construction markets that may be attributable to the CCEI. The method for estimating CCEI's program savings follows the framework shown in Figure 1. Although the Massachusetts Program Administrators (PAs) developed this framework, Rhode Island and Massachusetts work closely together and the structure of the states' code enhancement programs are very similar. The attribution assessment relies on results from new construction baseline studies conducted both before and several years after National Grid established the CCEI program. This paper focuses on the process used to conduct the attribution assessment.

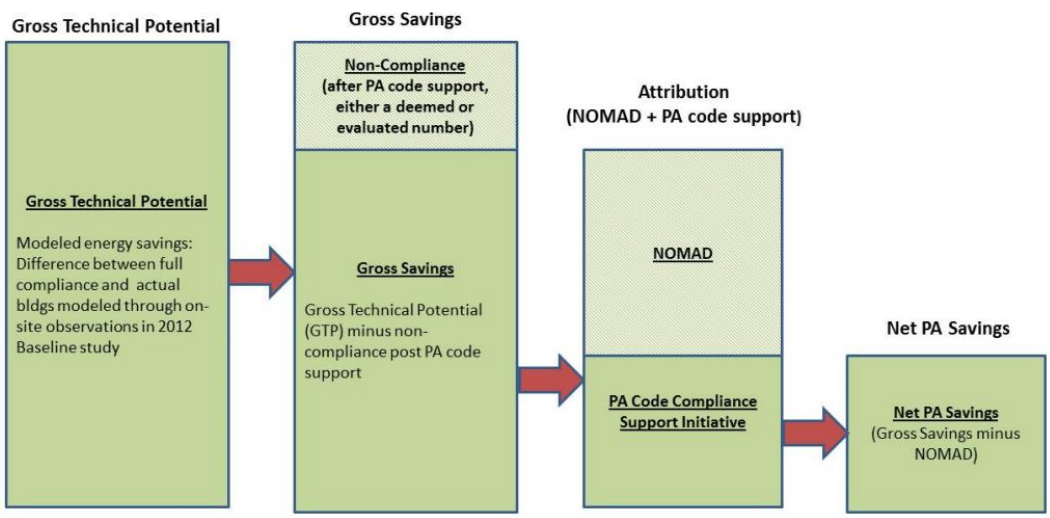

Figure 1. Steps Involved in Net Savings Calculation. Source: Massachusetts Program Administrators. 2015. Savings & Evaluation Methodology for Codes and Standards Initiative.

Since launching in 2013, the CCEI has delivered nearly 200 trainings to code officials and building professionals to help them stay abreast of building code requirements. The sessions range from one to three hours and are conducted in a classroom setting, online, and in the field. CCEI activities also include stakeholder engagement, resource development, and direct technical assistance. Prior to establishing the CCEI, National Grid offered support through a number of initiatives, and various other organizations also provided training and support to code officials and building professionals.[1]

Figure 2 provides a timeline of trainings delivered by the CCEI within the context of Rhode Island's recent code cycles and baseline studies. Rhode Island adopted a locally amended version of the International Energy Conservation Code (IECC) as the basis of its energy code, and the dates above the timeline represent when Rhode Island adopted each code edition. The boxes at the bottom of the timeline indicate the estimated completion dates of the buildings that were included in the residential and commercial baseline studies.

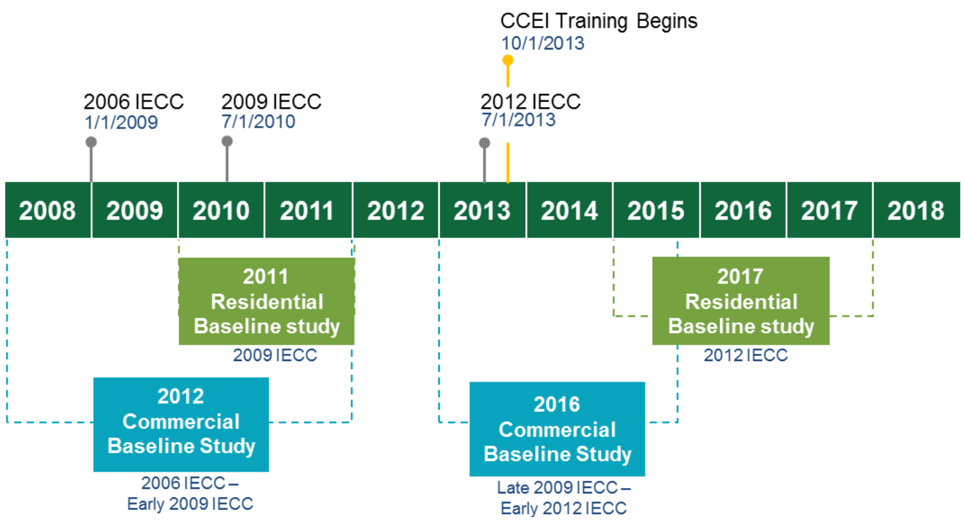

Figure 2. Timeline of training delivered by the CCEI and Rhode Island code cycles

Methodology

The process of assessing the savings attributable to the CCEI was divided into two main tasks: 1) develop an "attribution score" that reflects the proportion of improved efficiency that can be attributed to the CCEI and 2) calculate gross technical potential (GTP) energy savings. These two inputs are critical to estimating and projecting net savings (i.e., the energy savings attributable to the CCEI program), and developing each one involved multiple steps.

Figure 3 illustrates the approach that we used to calculate these two inputs. This paper focuses on the process that generates the "attribution score," which is divided into seven steps as indicated below. Within each step, we have indicated the source(s) that we used and noted whether it informed the residential or commercial estimates. As explored in the next section, the general logic was largely the same for both sectors, but there were key differences based on the nature of the respective markets and key sources of data. While the evaluation team relied largely

[1] National Grid has been conducting residential code trainings for many years (primarily through the New Construction program). Since 2011, National Grid has included commercial buildings code training as well. In addition to formal trainings, National Grid has regularly performed outreach to trade allies. Other organizations include building official and other professional associations, which led trainings with its members prior to when National Grid established the CCEI.

on its own professional judgment to derive core assumptions and estimates, the study was properly vetted with program staff and relevant stakeholders.

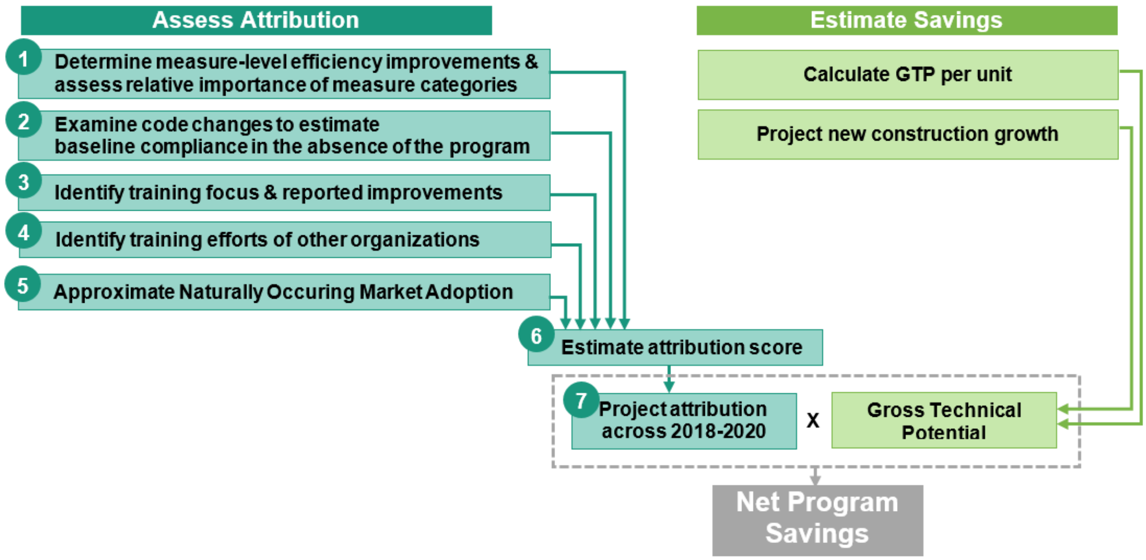

Figure 3. Study Approach.

The second task of estimating savings relied on different sources. The team derived residential savings estimates primarily from the Rhode Island 2017 residential new construction baseline study and supplemented results from this study with data from recent lighting studies in Massachusetts to further refine estimated lighting savings (NMR 2018; NMR 2016b; NMR 2016c). The team estimated commercial savings largely from modeled data from National Grid's 2016 commercial code compliance study (NBI and Madison Engineering 2017). We used additional datasets to estimate market segments, growth, and other trends in the commercial new construction market. This task is not the focus of this paper, but the full report offers details on the savings calculations (NMR 2017).

Results and Analysis

Step 1: Determine measure-level efficiency improvements and assess relative importance of measure categories

Based on the data available to the team, the first step of the residential attribution assessment involved examining results from the state's 2011 and 2017 residential baseline studies to determine which of the nine energy efficiency measure categories analyzed in these reports showed an improved level of average efficiency before and after the CCEI was implemented (Table 1). Next, we calculated the relative importance of the measure categories based on their contributions to overall household energy consumption models that were developed as part of the 2017 residential baseline study (NMR 2018). The consumption values were converted to percentages based on the proportional importance of each measure.

Table 1. Change in Measure-Level Efficiencies and Relative Importance (Residential)

Measures (Units)	2011 Efficiency	2017 Efficiency	Improved Efficiency	Relative Importance
Window and skylight (U-factor)	0.34	0.31	Yes	20%
Air leakage (ACH50)	5.96	5.24	Yes	19%
Above grade wall insulation (R-value)	17.7	19.8	Yes	17%
Flat ceiling insulation (R-value)	34.6	36.1	Yes	12%
Duct leakage to the outside (CFM25/100 sq. ft. CFA)	20.0	8.6	Yes	10%*
Frame floor insulation (R-value)	18.3	20.0	Yes	8%
Lighting (% of fixtures)	16%	66%	Yes	8%
Slab insulation (R-value)	2.5	3.6	Yes	3%
Foundation wall insulation (R-value)	18.6	7.9	No	3%

* Includes insulation.

For the commercial attribution assessment, the team reviewed energy modeling results from the 2012 and 2016 commercial baseline studies to determine which individual measures and measure categories displayed improved efficiencies (DNV GL, ERS, and APPRISE 2012, DNV GL 2016). The modeling results assessed gross technical potential energy savings from compliance enhancement by comparing the 2012 and 2016 baseline building practices to the 2009 and 2012 IECC, which were the respective energy codes in Rhode Island at the time these studies were conducted. Using the modeled results, we identified which measure categories had improved between the two baseline studies.

Table 2 displays the measure categories that were considered in this assessment. If a measure displayed lower potential savings in 2016 than in 2012 (meaning the market's competency in complying with that measure relative the active code requirement had improved) then it warranted inclusion in the attribution assessment. Higher potential savings in 2016 versus 2012 indicated a decrease in efficiency, and the related measures warranted little consideration in the attribution assessment. The results revealed improved efficiencies for building envelope and HVAC measures, but not for lighting. The modeled results were supported by the 2012 and 2016 compliance study findings for prescriptive compliance, which showed that the lighting measure category displayed only a 1% improvement in compliance between the two studies (DNV GL 2016). Based on these findings, we determined that the savings that may be attributed to lighting were relatively small.

Table 2. Changes in Measure Category Efficiencies and Relative Importance (Commercial)

Measure Category	2012 Potential Savings (kBtu/sf)	2016 Potential Savings (kBtu/sf)	Δ Potential Savings (kBtu/sf)	Improved Efficiency	Relative Importance
HVAC	0.07	2.79	2.72	Yes	46%
Building Envelope	0.52	1.67	1.15	Yes	39%
Lighting	1.37	0.77	-0.60*	No	15%

*Note that the 2012 and 2016 compliance studies showed an overall 1% increase in lighting compliance rates.

As with the residential attribution assessment we calculated the relative importance of the three measure categories from the 2016 commercial baseline study. For commercial assessment, we relied on the Pacific Northwest National Laboratory (PNNL) code compliance checklist point system (U.S. DOE, 2010), which assigns various building characteristics a value of one, two, or three points (with a lower score corresponding to higher impact on energy use). Adding up the checklist's points for individual measures, HVAC had the greatest relative value (46% of all points), followed by building envelope (39%) and lighting (15%).

Step 2: Examine code changes to estimate baseline compliance in the absence of the program

As shown in Figure 2, Rhode Island updated its energy code in 2013. Since this date falls between both of the state's two residential baseline studies (2011 and 2017) and commercial baseline studies (2012 and 2016), the impact of this code change on compliance with the measures identified in Step 1 must be considered.

For most measures, the residential code provisions in the 2009 IECC and the 2012 IECC for Rhode Island's climate zone were similar in terms of energy impact. For certain measures where there were notable increases in efficiency between the two versions – namely more stringent requirements for air leakage, duct sealing, and ceiling insulation – Rhode Island's amendments to the 2012 IECC either maintained or only minimally increased efficiency.

Although the code changes on the commercial side were more substantial, there was not sufficient information to quantify those effects. Given the lag time in commercial construction (assumed to be one to five years) along with the unclear timeline regarding future code adoption in Rhode Island, we assumed that commercial buildings completed in the 2018-2020 period would all be built under the 2012 IECC requirements.

At the time of this study, the timeline for future code changes in Rhode Island was unclear. While Rhode Island statute requires triennial review of its energy code (in alignment with the three-year national model code development cycle), the state was still enforcing an amended version of the 2012 IECC that it adopted in 2013. Given that there was no indication that Rhode Island would be adopting a more stringent code in the near future, it was reasonable, if conservative, to assume that residential and commercial buildings completed in the 2018-2020 period would all be built under the state's amended version of the 2012 IECC.

Step 3: Identify training focus and reported improvements

The evaluation team reviewed the CCEI materials to assess which building practices were targeted by the trainings. Roughly 100 hours of residential trainings were offered between 2013 and 2016. Air leakage received the greatest emphasis; it was covered in all of the classroom trainings, and the training contractor also offered a separate in-field training covering blower door test concepts and procedures. Other areas that were emphasized by the CCEI include ceiling insulation, above grade wall insulation, and duct leakage and insulation. To inform the proportion of code compliance that could be attributed to CCEI efforts, and to develop attribution factors for the program, we also took into account training participants' assessment of the effects of the trainings on their professional practices (NMR 2017). Participants reported the greatest impacts on their knowledge and understanding of the following areas: air leakage, duct leakage, and insulation.

For the commercial trainings, aligning the training topics with the measure categories from the commercial baseline studies shows that building envelope received the greatest emphasis, followed by lighting and HVAC. As with the residential trainings, we considered the

CCEI training evaluation results, which indicated the greatest areas of impact were on building envelope, followed by lighting and HVAC.

Step 4: Identify training efforts of other organizations

In addition to reviewing the CCEI training efforts, we sought to identify other efforts designed to support code compliance in Rhode Island (NMR 2017). Our research revealed that other entities had little to no direct impact on residential or commercial code compliance, as only a couple of organizations were even indirectly involved in compliance trainings. As a result, there was no compelling reason to incorporate other organizations into the attribution assessment.

Step 5: Approximate Naturally Occurring Market Adoption (NOMAD)

In lieu of having data from multiple Rhode Island baseline studies collected before CCEI that would allow us to measure NOMAD directly, results from residential baseline studies in Massachusetts allowed us to estimate the effects of NOMAD in Rhode Island.

The team examined results from two Massachusetts studies: the 2011 residential baseline and the 2015 residential baseline (Table 3). The 2011 study included homes built during the beginning of the 2009 IECC code cycle in Massachusetts. The 2015 study included a sample of homes built at the end of 2009 IECC code cycle and a sample built at the beginning of the 2012 IECC code cycle. Crucially, during the time of construction for homes in both baseline studies, Massachusetts did not have a training-related program to increase code compliance. Therefore, by comparing baseline results from the 2011 baseline to the 2009 IECC group from the 2015 baseline study, the team was able to estimate a proxy for NOMAD over the period of the 2009 IECC as builders and other market actors became more accustomed to the code requirements (column G in Table 3). Additionally, the early 2012 IECC sample can be compared to the late 2009 IECC sample to estimate a proxy for impacts resulting from the adoption of 2012 IECC requirements (column H). Such a proxy only works for measures in which Massachusetts and Rhode Island enforced similar 2012 IECC requirements. In other words, it does not apply to measures such as air leakage and ceiling insulation, which Rhode Island amended.[2]

Note that we did not have comparable data for the commercial sector, so the commercial attribution score does not account for NOMAD.

[2] A substantial amount of non-participant spillover from the Residential New Construction (RNC) program has been measured in Massachusetts. That said, if we assume that the RNC spillover was the same for the beginning and end of 2009 IECC baseline inspections in Massachusetts, then we can assume that the net efficiency change is still representative of NOMAD and can be applied to Rhode Island.

Table 3. Comparison of Rhode Island and Massachusetts Efficiency Changes

	Rhode Island			Massachusetts					
	2011 Study	2017 Study	Relative Change	2011 Study	2015 Study (End of	2015 Study (Start of 2012 IECC)	Change During 2009 IECC	Change from 2009 IECC to 2012 IECC	Overall Change
Measures (Units)	A	B	C= B-A	D	E	F	G= E-D	H= F-E	I= G+H
Window and skylight (U-factor) *	0.34	0.31	0.03	0.34	0.32	0.29	0.02	0.03	0.05
Air leakage (ACH50) *	5.96	5.24	0.72	4.78	4.80	3.60	-0.02	1.2	1.18
Above grade wall (R-value)	17.7	19.8	2.1	19.4	20.3	20.6	0.9	0.3	1.2
Flat ceiling (R-value)	34.6	36.1	1.5	36.8	39	42.4	2.2	3.4	5.6
Duct leakage to the outside (CFM25/100 sq. ft. CFA) *	20.0	8.6	11.4	12.4	6.3	3.9	6.1	2.4	8.5
Frame floor (R-value)	18.3	20	1.7	26.7	29.6	31.8	2.9	2.2	5.1
Lighting (% of efficient sockets)	16%	66%	50%	23%	45%	47%	22%	2%	24%
Slab (R-value) **	2.5	3.6	1.1	--	--	--	--	--	--
Foundation wall (R-value)**	18.6	7.9	-10.7	--	--	--	--	--	--

* Lower values for window and skylight, air leakage, and duct leakage indicate improved efficiency. The relative improvement (absolute value) for all measures is reported above.
** Results were excluded due to unreliable data and small sample sizes.

Step 6A: Estimate the Residential Attribution Score

It is difficult to quantify the exact proportions that improved measure efficiency can be attributed to CCEI, but our qualitative assessment taking into consideration the various factors above provides some general guidelines. The team determined that the CCEI appeared to warrant attribution for only a few measures (Figure 4). It was reasonable to assume that the CCEI program had little to no direct effect on slab insulation and foundation wall insulation based on the relatively lower efficiency improvement, the lower relative importance of the measure, and the relatively lower estimated impact of the trainings. It was not appropriate to assign attribution CCEI for measures where it appeared that NOMAD accounted for virtually all of the increased efficiency, including the following measures: window and skylight U-factor, frame floor insulation, and ceiling insulation.

Measure	Improved Efficiency?	Relative Importance	Impact of Training	Is improved efficiency > NOMAD?	Assign Attribution to CCEI?
Window and skylight	Yes	20%	Low	No	No
Air leakage	Yes	19%	High	No	Yes
Above grade wall insulation	Yes	17%	Medium	Yes	Yes
Ceiling insulation	Yes	12%	Medium	No	No
Duct leakage	Yes	10%	High	Yes	Yes
Frame floor insulation	Yes	8%	Medium	No	No
Lighting	Yes	8%	Low	Yes	Yes
Slab insulation	Yes	3%	Low	--	No
Foundation wall insulation	No	3%	Low	--	No

Figure 4. Factors Contributing to Measure-Level Attribution

We assigned attribution to the CCEI for the following select measures:

Air Leakage: The CCEI trainings focused heavily on air sealing practices, and the majority of participants indicated that the trainings had affected or would positively affect their practices. Furthermore, NOMAD seemed to have had relatively little effect on this area: the 2009 IECC NOMAD was near zero in Massachusetts, and there was almost no NOMAD or code-driven change from the switch from the 2009 IECC to the amended 2012 IECC in Rhode Island because the amended state code does not have a prescriptive threshold.[3] Still, the team assumed some code-driven increases from the code update because of the requirement that buildings undergo a performance-based air leakage test. The team assumed that 25% of the air leakage improvements in Massachusetts between the end of the 2009 IECC and the beginning of the 2012 IECC were driven by the requirement that all homes have a performance-based blower door test.[4] In Rhode Island, air leakage improved from 5.96 ACH50 to 5.24 ACH50. Given these factors, we estimated that 60% of this improvement was attributable to CCEI.

Above grade wall insulation: Since the requirement did not change between the 2009 IECC and the 2012 IECC, all baseline improvement in Massachusetts was assumed to be due to NOMAD. From the beginning of the 2009 code cycle to after the adoption of the 2012 IECC, NOMAD led to an increase in Massachusetts of R-1.2. In Rhode Island, the improvement during this period was R-2.2. Since NOMAD appeared to account for at least half of the change and evaluation results only indicated moderate impact on practices, we estimated that 35% of the change in Rhode Island could be attributed to CCEI.

Duct leakage: The CCEI trainings have a strong emphasis on duct sealing, which is an area that trainees credited the trainings for in improving their practices. The NOMAD under the 2009 IECC in Massachusetts (6.1 CFM25/100 sq. ft.) would account for more than half the change in Rhode Island (11.4), and the adoption of 2012 IECC in Massachusetts accounts for an additional portion; however, this entire amount is not completely applicable since the Rhode Island amended code is less stringent than Massachusetts.[5] Thus, we conservatively estimated that 45%, or slightly less than one-half, of the increased efficiency could be attributed to CCEI.

Lighting: In Rhode Island, there was a substantial increase in the percentage of efficient lighting between the baseline studies. At the same time, there was a major increase in code stringency. In Massachusetts, the 2009 IECC code-cycle NOMAD resulted in a doubling of the percentage of efficient lighting, and there was a slight increase in compliance after the adoption of the 2012 IECC. In Rhode Island, after accounting for a doubling of compliance due to NOMAD, a 34% increase in compliance was still unaccounted for. Factoring in the low impact of training, indicated by evaluation results and training time spent on lighting, we estimated that a 20% increase in efficiency was attributable to CCEI.

We calculated the overall residential attribution score of 23% by multiplying the measure-level attribution scores by their relative importance (Table 4).

[3] Based on trainings, we assumed that builders knew only testing was required and that there was no prescriptive threshold.

[4] In Massachusetts, there was a decrease of 1.2 ACH50 between the late 2009 IECC sample and the early 2012 IECC sample. In Rhode Island, there was a decrease of 0.72 ACH50 between the 2009 IECC and amended 2012 IECC. Since Rhode Island's amended 2012 IECC only included a requirement of performance testing and did not include an actual ACH50 threshold, only 25% (0.3) of the Massachusetts proxy is considered applicable. Therefore, we assume 0.42 ACH50 or about 60% of the decrease in ACH50 in Rhode Island is attributable to the program.

[5] Massachusetts requires 4 CFM25/100 sf of total leakage while RI requires 8 CFM25/100 sf.

Table 4. Residential Attribution Scores for CCEI

Measure	Relative Importance (A)	% Attributable to CCEI (B)	Attribution Score (A*B)
Window and skylight U-factor	20%	0%	0%
Air leakage	19%	60%	11%
Above grade wall insulation	17%	35%	6%
Ceiling insulation	12%	0%	0%
Duct leakage and insulation	10%	45%	5%
Frame floor insulation	8%	0%	0%
Lighting	8%	20%	2%
Slab insulation	3%	0%	0%
Foundation wall insulation	3%	0%	0%
Attribution Score (Sum of Component Scores)			23%

Step 6B: Estimate the Commercial Attribution Score

As with residential buildings, results from Steps 1-5 informed the factors that contributed to the commercial attribution score. Using a similar rationale, we determined that the building envelope category should have the highest attribution rate, followed by HVAC and lighting as shown in Figure 5.

Measure Category	Improved Efficiency	Relative Importance	Training Focus	Impact of Training	Attribution Ranking
Building Envelope	Medium	Medium	High	Medium	High
HVAC	High	High	Low	Low	Medium
Lighting	Low	Low	Medium	High	Low

Figure 5. Factors Contributing to Measure-Group Attribution

Based on this evidence, we felt that a general starting point for overall attribution would be 50% for the building envelope and HVAC measure categories. Although the HVAC category showed the greatest improvements in efficiency, the content of the trainings and the effect on participants, appeared to have a greater impact on practices associated building envelope (e.g., increased knowledge of building science principles), which would justify a slightly higher attribution level. While lighting had shown little to no improvement between the 2012 and 2016 commercial baseline studies (a 1% increase in compliance), we recommended an attribution score of 25%. This score was influenced by the fact that the CCEI had held lighting-specific trainings and evaluation results indicated that attendees found these trainings the most useful. We also assumed that lighting compliance would increase over the 2018-2020 period, a portion of which would be attributable to CCEI. Overall, based on these factors, it seemed reasonable to apply a 55% attribution score to building envelope, 45% to HVAC, and 25% to lighting. The team calculated the overall score of 46% by multiplying the measure category attribution scores by their relative importance (Table 5).

Table 5. Commercial Attribution Scores for CCEI

Measure Category	Relative Importance (A)	% Attributable to CCEI (B)	Attribution Score (A*B)
Building Envelope	39%	55%	21%
HVAC	46%	45%	21%
Lighting	15%	25%	4%
Attribution Score (Sum of Component Scores)			46%

Step 7: Project Residential and Commercial Attribution across the 2018-2020 Period

Table 6 presents the calculations that the team used to project the residential and commercial compliance and CCEI attribution. Each component is described in brief below; the full report provides more information on detailed calculations and assumptions (NMR 2017).

Table 6. Compliance and CCEI Attribution Over Time

			2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Beginning of 2012 IECC Compliance Estimate	**A**	Res.	74%						
		Comm.	78%						
Compliance Estimate with the CCEI	**B**	Res.	76%	78%	80%	82%	84%	86%	88%
		Comm.	86%	88%	90%	92%	94%	95%	95%
Non-Compliance Estimate *Calculation: (1-B)*	**C**	Res.	24%	22%	20%	18%	16%	14%	12%
		Comm.	14%	12%	10%	8%	6%	5%	5%
Attribution Estimate	**D**	Res.	23%						
		Comm.	46%						
Compliance without the CCEI *Calculation: ((B-A)*(1-D))+A*	**E**	Res.	76%	77%	79%	80%	82%	83%	85%
		Comm.	82%	83%	85%	86%	87%	87%	87%
Compliance Attributable to CCEI *Calculation: (B-E)*	**F**	Res.	1%	1%	1%	2%	2%	3%	3%
		Comm.	4%	5%	6%	6%	7%	8%	8%
Percentage of Maximum Potential Improvement Attributable to CCEI *Calculation: F/(1-A)*	**G**	Res.	2%	4%	5%	7%	9%	11%	13%
		Comm.	17%	21%	25%	29%	33%	36%	36%

Beginning of 2012 IECC compliance estimate (A): We assumed that, in the absence of the CCEI program, the code compliance rate at the beginning of the 2012 IECC would have been the same as at the beginning of the 2009 IECC. For residential new construction, we assumed 74% based on results from the 2011 and 2017 residential baseline studies. For commercial new construction, we assumed 78% based on the 2012 and 2016 commercial baseline studies.

Annual Compliance Estimate with the CCEIs (B): We projected compliance to increase slightly over time since we expected that the code will not be updated in Rhode Island during this period. For residential new construction, we assumed a compliance cap of 88% by 2020. For commercial new construction, we assumed a 95% compliance cap, to be achieved by 2019. These values were based on trends from the respective baseline studies and the fact that we anticipate an enduring level of non-compliance.

Non-Compliance Estimates (C): This is simply the remaining non-compliance in the residential and commercial new construction markets each year.

*Attribution Estimate (D)***:** These are the overall scores in Table 4 and Table 5. We felt it appropriate to assume a stable value for the projected period since the residential and commercial building codes are unlikely to change for the projected period and we anticipated that the CCEI will continue during this time.

Compliance without the CCEI (E): This is a calculated value based on the variables discussed above. This value represents NOMAD.

Compliance Attributable to CCEI (F): This is the difference between measured compliance rates with CCEI influence and our estimate of compliance without the program.

Percentage of Maximum Potential Improvement Attributable to CCEI (G): These values represent the compliance percentage that is attributable to the CCEI divided by the overall level of non-compliance that would exist in the absence of the program.

Conclusions and Recommendations

This study offers important insights for PAs in other jurisdictions interested in assessing attribution of energy code standards programs and for regulators and evaluators responsible for reviewing such assessments. Below are a few related considerations and implications:

PAs should design their energy code support programs to capture a variety of data types. This study used information from baseline studies that measured the rate at which new construction projects in Rhode Island complied with the active energy code before and after the CCEI was established. The content of the CCEI's training activities and evidence of its impact on participants were other sources of information. At the time of the study, program staff did not have accurate estimates of retrofit projects. Not claiming these savings underestimates the impact of the CCEI program, resulting in conservative estimates of attribution. A key lesson learned and related recommendation is to track estimates on the number of energy-related retrofit projects.

PAs should proactively identify data sources that aid development of reasonable assumptions regarding NOMAD. In addition to Rhode Island's baseline studies, we examined results from Massachusetts to establish previous market patterns. This proved valuable in approximating NOMAD for the residential attribution assessment. PAs with similar needs and under comparable conditions may wish to utilize research from a neighboring jurisdiction as a proxy for characteristics of the markets in which their programs operate. Relatedly, PAs who are contemplating a future codes and standards support program should consider conducting baseline compliance studies (if they have not already done so) to help with measuring NOMAD at a later date. In addition to setting the foundation for an attribution assessment, baseline studies provide valuable information on market conditions, which would provide an immediate benefit to PAs.

PAs should prioritize maintaining alignment between program planning and building energy code update cycles. The CCEI was established in Rhode Island shortly after the state adopted the 2012 IECC. This study was designed to coincide with the expected date of the state's subsequent code update to assess the impact of the CCEI for the entire period the 2012 IECC was in effect and project energy savings under the next code. However, the state's timeline for this code update is unclear, so we relied on conditions under the 2012 IECC for our 2018-2020 projections. The assumptions and estimates in this study would need to be reexamined if the state adopted a new code during the projected period.

Appliance and equipment standards present an opportunity to extend this approach. Finally, while this paper focused on building energy code compliance, product standards support programs could follow a similar evaluation structure. As of 2018, the CCEI is investigating the potential to expand into supporting product standards development. PAs interested in launching an energy code support program may wish to consider how these findings would relate to a more comprehensive program that also includes product standards support.

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